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# Lake Poinsett, Brookings and Hamlin Counties South Dakota

National Eutrophication Survey, Corvallis, Oreg

Prepared for

Corvallis Environmental Research Lab, Oreg

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# U.S. ENVIRONMENTAL PROTECTION AGENCY
# NATIONAL EUTROPHICATION SURVEY

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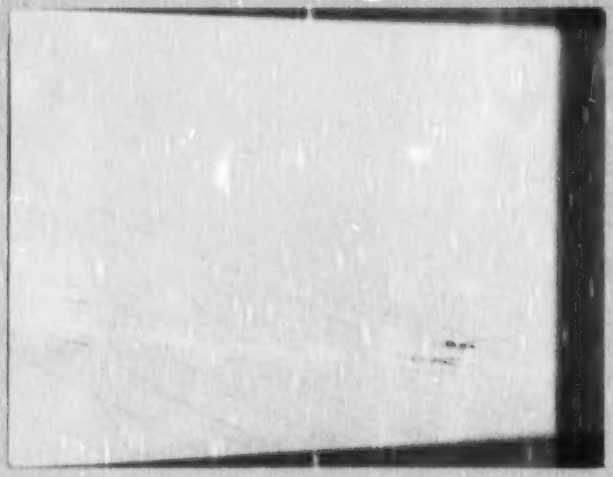

**CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON**

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REPORT

ON

# LAKE POINSETT

BROOKINGS AND HAMLIN COUNTIES

SOUTH DAKOTA

EPA REGION VIII

WORKING PAPER No. 619

WITH THE COOPERATION OF THE

SOUTH DAKOTA DEPARTMENT OF ENVIRONMENTAL PROTECTION

AND THE

SOUTH DAKOTA NATIONAL GUARD

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

| a. DESCRIPTORS | b. IDENTIFIERS/OPEN ENDED TERMS | c. COSATI Field/Group |
|---|---|---|
| eutrophication<br>lakes<br>nutrients<br>phosphorus<br>nitrogen<br>loading | | 05B<br>05C |

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# FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

## OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

## ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

## LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the South Dakota Departments of Environmental Protection and Game, Fish and Parks for professional involvement, to the South Dakota National Guard for conducting the tributary sampling phase of the Survey, and to those wastewater treatment plant operators who voluntarily provided effluent samples.

Allyn Lockner, Secretary, and Blaine Barker and Duane Murphy, Department of Environmental Quality; Douglas Hansen, Department of Game, Fish and Parks; and James Hayden, Director, State Lakes Preservation Committee provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

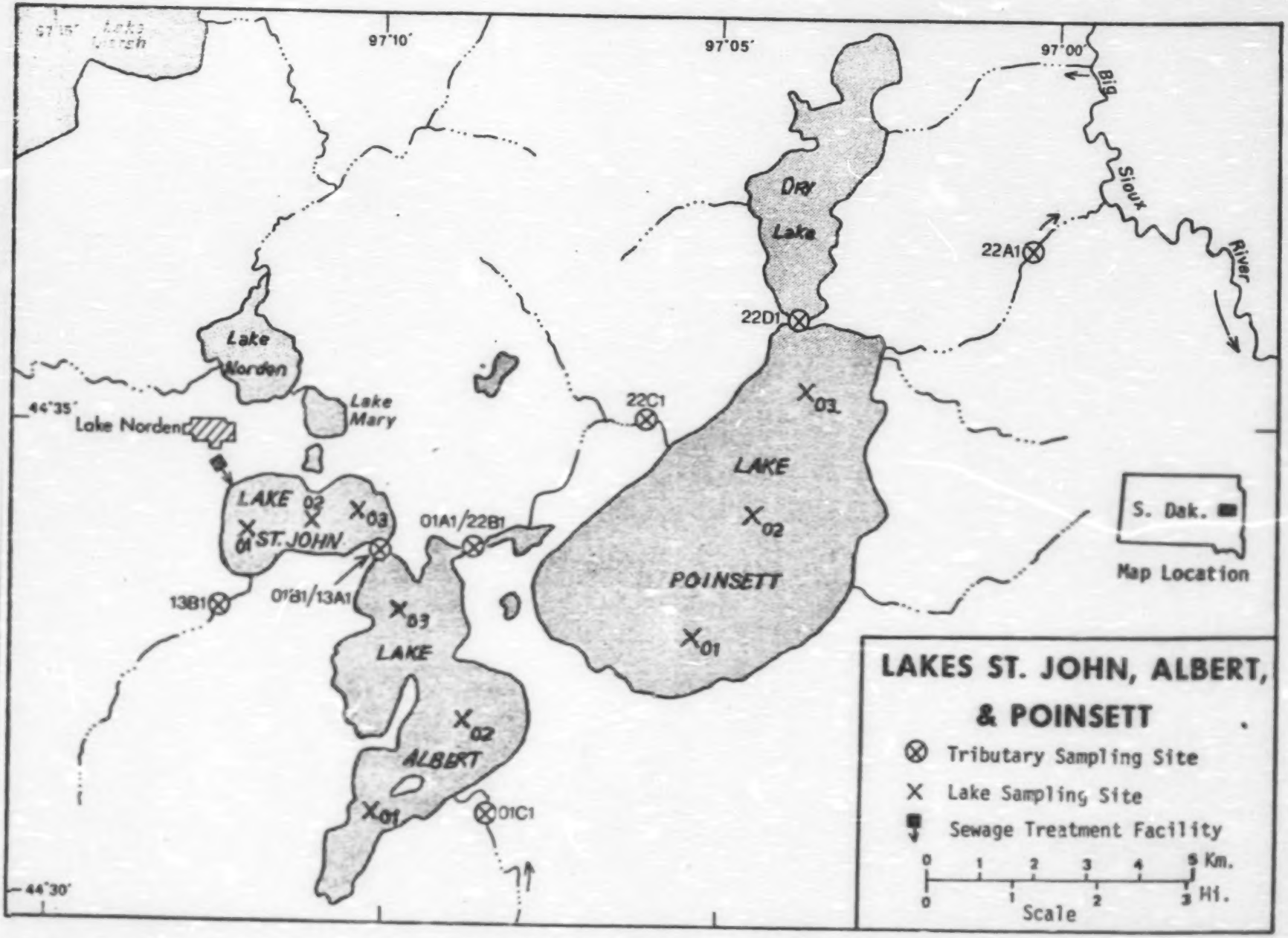
Major General Duane L. Corning, the Adjutant General of South Dakota, and Project Officer Colonel Robert D. Chalberg, who directed the volunteer efforts of the South Dakota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF SOUTH DAKOTA

| LAKE NAME | COUNTY |
|---|---|
| Albert | Kingsbury |
| Alvin | Lincoln |
| Angostura | Fall River |
| Brant | Lake |
| Byron | Beadle |
| Clear | Marshall |
| Clear | Minnehaha |
| Cochrane | Deuel |
| Cottonwood | Spink |
| Deerfield | Pennington |
| Enemy Swim | Day |
| Herman | Lake |
| John | Hamlin |
| Kampeska | Codington |
| Madison | Lake |
| Mitchell | Davidson |
| Norden | Hamlin |
| East Oakwood | Brookings |
| West Oakwood | Brookings |
| Pactola | Pennington |
| Pickerel | Day |
| Poinsett | Brookings, Lake |
| Red Iron South | Marshall |
| Richmond | Brown |
| Roy | Marshall |
| Sand | Brown |
| Sheridan | Pennington |
| Stockdale | Custer |
| East Vermillion | McCook |
| Wall | Minnehaha |
| Waubay | Day |


97°15'
Lake Marsh
97°10'
97°05'
97°00'
Big Sioux River
Dry Lake
22A1
22D1
Lake Norden
Lake Mary
44°35'
Lake Norden
22C1
LAKE ST. JOHN
01
02
03
01A1/22B1
13B1
01B1/13A1
LAKE POINSETT
LAKE ALBERT
01C1
44°30'
S. Dak.
Map Location
LAKES ST. JOHN, ALBERT, & POINSETT
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
0 1 2 3 4 5 Km.
0 1 2 3 Mi.
Scale

# LAKE POINSETT

## STORET NO. 4622

## I. INTRODUCTION

Due to the lack of flows, only a few tributary samples were collected at Lake Poinsett, and this report relates only to lake sampling data. The few tributary data obtained are included in Appendix E for the record.

Lake Poinsett is the largest natural lake managed for fisheries in South Dakota. It is of glacial origin and is situated in two extensive glacial outwash aquifers. One to the northeast connects Lake Poinsett to Dry Lake and the Big Sioux River, and another to the west connects Lake Poinsett and Lake Albert. Land use in the lake drainage is predominantly agricultural.

Lake Poinsett is used heavily for other recreational activities besides fishing. These include boating, swimming, water-skiing, camping, and picnicking. There are 467 lakeshore residences, most of which are summer homes. In addition, there are five resort areas located around the lake and privately-owned campgrounds on the west side (Sharps and Hanten, 1974).

## II. CONCLUSIONS

### A. Trophic Condition:

Survey data indicate that Lake Poinsett is eutrophic. It ranked nineteenth in overall trophic quality when the 31 South Dakota lakes sampled in 1974 were compared using a combination

of six water quality parameters*. Thirteen of the lakes had less median total phosphorus, 15 had less and one had the same median dissolved orthophosphorus, 28 had less median inorganic nitrogen, 17 had less mean chlorophyll a, and 17 had greater mean Secchi disc transparency.

Survey limnologists noted that the shoreline at station 3 was fringed with submerged vegetation and observed an algal bloom in progress in September.

Previous investigators of this lake have noted the advanced degree of eutrophication present in the lake and attribute it to the large annual nutrient load entering and retained in the lake (Skille, 1971).

B. Rate-Limiting Nutrient:

The algal assay results indicate that Lake Poinsett was limited by phosphorus at the time the sample was collected (04/25/74). The lake data indicate phosphorus limitation in April but nitrogen limitation in July and September.

* See Appendix A.

## III. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

### A. Lake Morphometry††:

1. Surface area: 29.26 kilometers².
2. Mean depth: 2.9 meters.
3. Maximum depth: 5.9 meters.
4. Volume: 84.854 x $10^6$ $m^3$.
5. Mean hydraulic retention time: 35.4 years.

### B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

| Name | Drainage area ($km^2$)* | Mean flow ($m^3$/sec)* |
|---|---|---|
| Unnamed Stream B-1 | 608.6 | 0.064 |
| Minor tributaries & immediate drainage - | 95.1 | 0.009 |
| Totals | 703.7 | 0.073 |

2. Outlet -

| | | |
|---|---|---|
| Unnamed Stream A-1 | 733.0** | 0.073** |

### C. Precipitation***:

1. Year of sampling: 37.2 centimeters.
2. Mean annual: 56.2 centimeters.

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† Table of metric conversions--Appendix B.
†† Murphey, 1974.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake; outflow adjusted to equal sum of inflows.
*** See Working Paper No. 175.

## IV. LAKE WATER QUALITY SUMMARY

Lake Poinsett was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two or more depths at three stations on the lake (see map, page v). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 2.1 meters at station 1, 3.7 meters at station 2, and 3.0 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR LAKE POINSETT
STORET CODE 4622

| PARAMETER | 1ST SAMPLING ( 4/25/74) 3 SITES RANGE | MEAN | MEDIAN | 2ND SAMPLING ( 7/12/74) 3 SITES RANGE | MEAN | MEDIAN | 3RD SAMPLING ( 9/19/74) 3 SITES RANGE | MEAN | MEDIAN |
|---|---|---|---|---|---|---|---|---|---|
| TEMP (C) | 9.5 - 10.2 | 9.7 | 9.6 | 24.0 - 24.5 | 24.3 | 24.4 | 15.9 - 16.3 | 16.1 | 16.1 |
| DISS OXY (MG/L) | 8.4 - 10.2 | 9.4 | 9.6 | 5.0 - 7.8 | 6.0 | 6.1 | 8.6 - 9.4 | 9.1 | 9.2 |
| CNDCTVY (MCROMO) | 774. - 783. | 777. | 776. | 1179. - 1193. | 1187. | 1187. | 1030. - 1049. | 1039. | 1037. |
| PH (STAND UNITS) | ****** -********** | | | 8.8 - 9.2 | 8.9 | 8.9 | 8.4 - 8.5 | 8.5 | 8.5 |
| TOT ALK (MG/L) | 180. - 214. | 205. | 210. | 252. - 338. | 275. | 269. | 245. - 325. | 297. | 305. |
| TOT P (MG/L) | 0.052 - 0.174 | 0.104 | 0.094 | 0.166 - 0.241 | 0.207 | 0.206 | 0.087 - 0.108 | 0.096 | 0.095 |
| ORTHO P (MG/L) | 0.007 - 0.047 | 0.024 | 0.022 | 0.067 - 0.106 | 0.090 | 0.092 | 0.005 - 0.007 | 0.006 | 0.006 |
| NO2+NO3 (MG/L) | 0.180 - 0.250 | 0.219 | 0.240 | 0.140 - 0.200 | 0.169 | 0.170 | 0.020 - 0.020 | 0.020 | 0.020 |
| AMMONIA (MG/L) | 0.050 - 0.320 | 0.251 | 0.280 | 0.110 - 0.440 | 0.247 | 0.160 | 0.040 - 0.050 | 0.044 | 0.040 |
| KJEL N (MG/L) | 0.200 - 2.900 | 2.200 | 2.500 | 2.600 - 3.200 | 2.862 | 2.800 | 2.300 - 2.300 | 2.300 | 2.300 |
| INORG N (MG/L) | 0.150 - 0.550 | 0.470 | 0.510 | 0.270 - 0.620 | 0.416 | 0.345 | 0.060 - 0.070 | 0.064 | 0.060 |
| TOTAL N (MG/L) | 0.300 - 3.150 | 2.419 | 2.740 | 2.790 - 3.360 | 3.031 | 2.990 | 2.320 - 2.320 | 2.320 | 2.320 |
| CHLRPYL A (UG/L) | 7.4 - 24.3 | 18.5 | 23.7 | 31.3 - 132.1 | 70.9 | 49.4 | 25.5 - 39.5 | 31.2 | 28.7 |
| SECCHI (METERS) | 0.8 - 1.1 | 1.0 | 1.0 | 0.5 - 0.9 | 0.6 | 0.5 | 0.8 - 0.9 | 0.8 | 0.8 |

B. Biological characteristics:

1. Phytoplankton -

| Sampling Date | Dominant Genera | Algal Units per ml |
|---|---|---|
| 04/25/74 | 1. Chroomonas sp. | 3,604 |
| | 2. Cryptomonas sp. | 1,984 |
| | 3. Flagellates | 1,214 |
| | 4. Microcystis sp. | 202 |
| | 5. Stephanodiscus sp. | 162 |
| | Other genera | 204 |
| | Total | 7,370 |
| 07/12/74 | 1. Oocystis sp. | 1,388 |
| | 2. Phormiduim sp. | 1,289 |
| | 3. Microcystis sp. | 991 |
| | 4. Cryptomonas sp. | 595 |
| | 5. Chroomonas sp. | 397 |
| | Other genera | 644 |
| | Total | 5,304 |
| 09/19/74 | 1. Aphanizomenon sp. | 2,380 |
| | 2. Cyanophytan filaments | 641 |
| | 3. Oocystis sp. | 305 |
| | 4. Stipitococcus sp. | 244 |
| | 5. Stephanodiscus sp. | 153 |
| | Other genera | 945 |
| | Total | 4,668 |

2. Chlorophyll a -

| Sampling Date | Station Number | Chlorophyll a (µg/l) |
|---|---|---|
| 04/25/74 | 1 | 23.7 |
| | 2 | 24.3 |
| | 3 | 7.4 |
| 07/12/74 | 1 | 132.1 |
| | 2 | 31.3 |
| | 3 | 49.4 |
| 09/19/74 | 1 | 39.5 |
| | 2 | 25.5 |
| | 3 | 28.7 |

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

| Spike (mg/l) | Ortho P Conc. (mg/l) | Inorganic N Conc. (mg/l) | Maximum yield (mg/l-dry wt.) |
|---|---|---|---|
| Control | 0.020 | 0.312 | 0.8 |
| 0.050 P | 0.070 | 0.312 | 14.3 |
| 0.050 P + 1.0 N | 0.070 | 1.312 | 14.5 |
| 1.0 N | 0.020 | 1.312 | 0.7 |

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Lake Poinsett was moderate at the time the sample was collected (04/25/74). Also, the significant increase in yield with the addition of phosphorus alone indicates that the lake was limited by phosphorus at that time. Note that the addition of nitrogen alone resulted in a yield not significantly different from that of the control.

The lake data indicate phosphorus limitation in April as well; i.e., the mean inorganic nitrogen to orthophosphorus ratio was 20 to 1. However, nitrogen limitation is indicated in July and September (the mean N to P ratios were 5 to 1 or less, and nitrogen limitation would be expected).

## V. LITERATURE REVIEWED

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# VI. APPENDICES

## APPENDIX A

## LAKE RANKINGS

| LAKE CODE | LAKE NAME | MEDIAN TOTAL P | MEDIAN INORG N | 500-MEAN SEC | MEAN CHLORA | 15-MIN DO | MEDIAN DISS ORTHO P |
|---|---|---|---|---|---|---|---|
| 4601 | LAKE ALBERT | 0.321 | 0.170 | 469.111 | 106.289 | 9.200 | 0.019 |
| 4602 | ALVIN LAKE | 0.067 | 0.970 | 442.833 | 4.700 | 9.400 | 0.017 |
| 4603 | ANGOSTURA RESERVOIR | 0.019 | 0.160 | 423.333 | 3.717 | 13.000 | 0.005 |
| 4604 | BRANT LAKE | 0.194 | 0.130 | 432.833 | 34.150 | 11.800 | 0.113 |
| 4605 | LAKE BYRON | 0.443 | 0.370 | 488.333 | 149.350 | 9.000 | 0.146 |
| 4606 | CLEAR LAKE | 0.027 | 0.075 | 430.167 | 11.983 | 8.800 | 0.009 |
| 4607 | CLEAR LAKE | 1.400 | 0.270 | 495.333 | 691.000 | 7.000 | 0.468 |
| 4608 | COCHRANE LAKE | 0.037 | 0.150 | 446.000 | 15.683 | 15.000 | 0.008 |
| 4609 | COTTONWOOD LAKE | 0.685 | 0.265 | 490.333 | 112.017 | 8.600 | 0.417 |
| 4610 | DEERFIELD RESERVOIR | 0.033 | 0.080 | 303.333 | 3.650 | 15.000 | 0.022 |
| 4611 | ENEMY SWIM LAKE | 0.037 | 0.085 | 442.600 | 14.200 | 8.200 | 0.013 |
| 4612 | LAKE HERMAN | 0.340 | 0.155 | 485.000 | 58.733 | 8.600 | 0.174 |
| 4613 | ST JOHN LAKE | 0.348 | 0.080 | 489.400 | 120.880 | 9.800 | 0.025 |
| 4614 | LAKE KAMPESKA | 0.220 | 0.105 | 468.889 | 20.567 | 8.200 | 0.128 |
| 4615 | MADISON LAKE | 0.259 | 0.090 | 445.555 | 22.578 | 14.000 | 0.107 |
| 4616 | LAKE MITCHELL | 0.099 | 0.085 | 465.833 | 14.883 | 13.800 | 0.015 |
| 4617 | LAKE NORDEN | 0.256 | 0.165 | 488.667 | 46.800 | 10.000 | 0.050 |
| 4618 | OAKWOOD LAKE EAST | 0.146 | 0.175 | 487.000 | 113.600 | 10.000 | 0.009 |
| 4619 | OAKWOOD LAKE WEST | 0.181 | 0.135 | 485.833 | 159.667 | 9.600 | 0.021 |
| 4620 | PACTOLA RESERVOIR | 0.011 | 0.070 | 248.444 | 1.478 | 11.000 | 0.006 |
| 4621 | PICKEREL LAKE | 0.049 | 0.095 | 439.833 | 15.833 | 9.600 | 0.009 |
| 4622 | LAKE POINSETT | 0.115 | 0.315 | 468.444 | 40.211 | 10.000 | 0.023 |
| 4623 | LAKE RED IRON SOUTH | 0.042 | 0.110 | 430.333 | 6.883 | 7.600 | 0.010 |
| 4624 | RICHMOND LAKE | 0.187 | 0.150 | 410.000 | 18.467 | 10.000 | 0.144 |
| 4625 | ROY LAKE | 0.034 | 0.070 | 431.000 | 13.333 | 11.000 | 0.010 |
| 4626 | SAND LAKE | 0.489 | 0.110 | 471.800 | 65.790 | 12.800 | 0.288 |
| 4627 | SHERIDAN LAKE | 0.053 | 0.105 | 394.000 | 15.433 | 15.000 | 0.016 |
| 4628 | STOCKADE LAKE | 0.233 | 0.150 | 432.000 | 25.400 | 15.000 | 0.109 |

LAKE DATA TO BE USED IN RANKINGS

| LAKE CODE | LAKE NAME | MEDIAN TOTAL P | MEDIAN INORG N | 500-MEAN SEC | MEAN CHLORA | 15-MIN DO | MEDIAN DISS ORTHO P |
|---|---|---|---|---|---|---|---|
| 4629 | LAKE VERMILLION | 0.21[illegible] | 0.100 | 472.833 | 100.800 | 9.200 | 0.092 |
| 4630 | WALL LAKE | 0.194 | 0.160 | 441.667 | 55.267 | 7.400 | 0.076 |
| 4631 | WAUBAY LAKE NORTH | 0.098 | 0.145 | 469.555 | 127.033 | 11.400 | 0.023 |

| LAKE CODE | LAKE NAME | MEDIAN TOTAL P | MEDIAN INORG N | 500-MEAN SEC | MEAN CHLORA | 15-MIN DO | MEDIAN DISS ORTHO P | INDEX NO |
|---|---|---|---|---|---|---|---|---|
| 4601 | LAKE ALBERT | 20 ( 6) | 20 ( 6) | 10 ( 3) | 23 ( 7) | 68 ( 20) | 60 ( 18) | 201 |
| 4602 | ALVIN LAKE | 67 ( 20) | 0 ( 0) | 57 ( 17) | 90 ( 27) | 63 ( 19) | 63 ( 19) | 340 |
| 4603 | ANGOSTURA RESERVOIR | 97 ( 29) | 30 ( 9) | 87 ( 26) | 93 ( 28) | 20 ( 6) | 100 ( 30) | 427 |
| 4604 | BRANT LAKE | 40 ( 12) | 53 ( 16) | 70 ( 21) | 47 ( 14) | 27 ( 8) | 23 ( 7) | 260 |
| 4605 | LAKE BYRON | 10 ( 3) | 3 ( 1) | 17 ( 5) | 7 ( 2) | 73 ( 22) | 13 ( 4) | 123 |
| 4606 | CLEAR LAKE | 93 ( 28) | 93 ( 28) | 83 ( 25) | 83 ( 25) | 77 ( 23) | 90 ( 27) | 519 |
| 4607 | CLEAR LAKE | 0 ( 0) | 10 ( 3) | 0 ( 0) | 0 ( 0) | 100 ( 30) | 0 ( 0) | 110 |
| 4608 | COCHRANE LAKE | 83 ( 25) | 40 ( 11) | 50 ( 15) | 67 ( 20) | 5 ( 0) | 93 ( 28) | 338 |
| 4609 | COTTONWOOD LAKE | 3 ( 1) | 13 ( 4) | 3 ( 1) | 20 ( 6) | 82 ( 24) | 3 ( 1) | 124 |
| 4610 | DEERFIELD RESERVOIR | 90 ( 27) | 88 ( 26) | 97 ( 29) | 97 ( 29) | 5 ( 0) | 53 ( 16) | 430 |
| 4611 | ENEMY SWIM LAKE | 80 ( 24) | 82 ( 24) | 60 ( 18) | 77 ( 23) | 88 ( 26) | 73 ( 22) | 460 |
| 4612 | LAKE HERMAN | 17 ( 5) | 33 ( 10) | 27 ( 8) | 33 ( 10) | 82 ( 24) | 10 ( 3) | 202 |
| 4613 | ST JOHN LAKE | 13 ( 4) | 88 ( 26) | 7 ( 2) | 13 ( 4) | 53 ( 16) | 43 ( 13) | 217 |
| 4614 | LAKE KAMPESKA | 33 ( 10) | 65 ( 19) | 40 ( 12) | 57 ( 17) | 88 ( 26) | 20 ( 6) | 303 |
| 4615 | MADISON LAKE | 27 ( 8) | 77 ( 23) | 53 ( 16) | 53 ( 16) | 13 ( 4) | 30 ( 9) | 253 |
| 4616 | LAKE MITCHELL | 60 ( 18) | 82 ( 24) | 47 ( 14) | 73 ( 22) | 17 ( 5) | 70 ( 21) | 349 |
| 4617 | LAKE NORDEN | 23 ( 7) | 23 ( 7) | 13 ( 4) | 40 ( 12) | 45 ( 12) | 40 ( 12) | 184 |
| 4618 | OAKWOOD LAKE EAST | 53 ( 16) | 17 ( 5) | 20 ( 6) | 17 ( 5) | 45 ( 12) | 85 ( 25) | 237 |
| 4619 | OAKWOOD LAKE WEST | 50 ( 15) | 50 ( 15) | 23 ( 7) | 3 ( 1) | 58 ( 17) | 57 ( 17) | 241 |
| 4620 | PACTOLA RESERVOIR | 100 ( 30) | 98 ( 29) | 100 ( 30) | 100 ( 30) | 35 ( 10) | 97 ( 29) | 530 |
| 4621 | PICKEREL LAKE | 73 ( 22) | 73 ( 22) | 67 ( 20) | 63 ( 19) | 58 ( 17) | 85 ( 25) | 419 |
| 4622 | LAKE POINSETT | 57 ( 17) | 7 ( 2) | 43 ( 13) | 43 ( 13) | 45 ( 12) | 47 ( 14) | 242 |
| 4623 | LAKE RED IRON SOUTH | 77 ( 23) | 58 ( 17) | 80 ( 24) | 87 ( 26) | 93 ( 28) | 78 ( 23) | 473 |
| 4624 | RICHMOND LAKE | 47 ( 14) | 40 ( 11) | 90 ( 27) | 60 ( 18) | 45 ( 12) | 17 ( 5) | 299 |
| 4625 | ROY LAKE | 87 ( 26) | 98 ( 29) | 77 ( 23) | 80 ( 24) | 35 ( 10) | 78 ( 23) | 455 |
| 4626 | SAND LAKE | 7 ( 2) | 58 ( 17) | 33 ( 10) | 30 ( 9) | 23 ( 7) | 7 ( 2) | 158 |
| 4627 | SHERIDAN LAKE | 70 ( 21) | 65 ( 19) | 93 ( 26) | 70 ( 21) | 5 ( 0) | 67 ( 20) | 370 |
| 4628 | STOCKADE LAKE | 30 ( 9) | 40 ( 11) | 73 ( 22) | 50 ( 15) | 5 ( 0) | 27 ( 8) | 225 |

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

| LAKE CODE | LAKE NAME | MEDIAN TOTAL P | MEDIAN INORG N | 500-MEAN SEC | MEAN CHLORA | 15-MIN DO | MEDIAN DISS ORTHO P | INDEX NO |
|---|---|---|---|---|---|---|---|---|
| 4629 | LAKE VERMILLION | 37 ( 11) | 70 ( 21) | 30 ( 9) | 27 ( 8) | 68 ( 20) | 33 ( 10) | 265 |
| 4630 | WALL LAKE | 43 ( 13) | 27 ( 8) | 63 ( 19) | 37 ( 11) | 97 ( 29) | 37 ( 11) | 304 |
| 4631 | WAUBAY LAKE NORTH | 63 ( 19) | 47 ( 14) | 37 ( 11) | 10 ( 3) | 30 ( 9) | 50 ( 15) | 237 |

| RANK | LAKE CODE | LAKE NAME | INDEX NO |
|---|---|---|---|
| 1 | 4620 | PACTOLA RESERVOIR | 530 |
| 2 | 4606 | CLEAR LAKE | 519 |
| 3 | 4623 | LAKE RED IRON SOUTH | 473 |
| 4 | 4611 | ENEMY SWIM LAKE | 460 |
| 5 | 4625 | ROY LAKE | 455 |
| 6 | 4610 | DEERFIELD RESERVOIR | 430 |
| 7 | 4603 | ANGOSTURA RESERVOIR | 427 |
| 8 | 4621 | PICKEREL LAKE | 419 |
| 9 | 4627 | SHERIDAN LAKE | 370 |
| 10 | 4616 | LAKE MITCHELL | 349 |
| 11 | 4602 | ALVIN LAKE | 340 |
| 12 | 4608 | COCHRANE LAKE | 338 |
| 13 | 4630 | WALL LAKE | 304 |
| 14 | 4614 | LAKE KAMPESKA | 303 |
| 15 | 4624 | RICHMOND LAKE | 299 |
| 16 | 4629 | LAKE VERMILLION | 265 |
| 17 | 4604 | BRANT LAKE | 260 |
| 18 | 4615 | MADISON LAKE | 253 |
| 19 | 4622 | LAKE POINSETT | 242 |
| 20 | 4619 | OAKWOOD LAKE WEST | 241 |
| 21 | 4631 | WAUBAY LAKE NORTH | 237 |
| 22 | 4618 | OAKWOOD LAKE EAST | 237 |
| 23 | 4628 | STOCKADE LAKE | 225 |
| 24 | 4613 | ST JOHN LAKE | 217 |
| 25 | 4612 | LAKE HERMAN | 202 |
| 26 | 4601 | LAKE ALBERT | 201 |
| 27 | 4617 | LAKE NORDEN | 184 |
| 28 | 4626 | SAND LAKE | 158 |

LAKES RANKED BY INDEX NOS.

| RANK | LAKE CODE | LAKE NAME | INDEX NO |
|---|---|---|---|
| 29 | 4609 | COTTONWOOD LAKE | 124 |
| 30 | 4605 | LAKE BYRON | 123 |
| 31 | 4607 | CLEAR LAKE | 110 |

## CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x $8.107 \times 10^{-4}$ = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

# APPENDIX C

## TRIBUTARY FLOW DATA

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# TRIBUTARY FLOW INFORMATION FOR SOUTH DAKOTA

06/04/76

LAKE CODE 4622 POINSETT

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 733.0

| TRIBUTARY | SUB-DRAINAGE AREA(SQ KM) | NORMALIZED FLOWS(CMS) JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4622A1 | 733.0 | 0.0 | 0.0 | 0.170 | 0.311 | 0.198 | 0.085 | 0.057 | 0.028 | 0.028 | 0.028 | 0.0 | 0.0 | 0.076 |
| 462281 | 556.8 | 0.0 | 0.0 | 0.142 | 0.283 | 0.142 | 0.085 | 0.057 | 0.028 | 0.028 | 0.0 | 0.0 | 0.0 | 0.064 |
| 4622ZZ | 176.1 | 0.0 | 0.0 | 0.0 | 0.028 | 0.028 | 0.028 | 0.028 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.009 |

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 733.0
SUM OF SUB-DRAINAGE AREAS = 733.0

TOTAL FLOW IN = 0.88
TOTAL FLOW OUT = 0.91

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

| TRIBUTARY | MONTH | YEAR | MEAN FLOW | DAY | FLOW | DAY | FLOW | DAY | FLOW |
|---|---|---|---|---|---|---|---|---|---|
| 4622A1 | 10 | 74 | 0.0 | 12 | 0.0 | | | | |
| | 11 | 74 | 0.0 | 16 | 0.0 | | | | |
| | 12 | 74 | 0.0 | 14 | 0.0 | | | | |
| | 1 | 75 | 0.0 | 25 | 0.0 | | | | |
| | 2 | 75 | 0.0 | 18 | 0.0 | | | | |
| | 3 | 75 | 0.0 | 20 | 0.0 | | | | |
| | 4 | 75 | 0.0 | 14 | 0.0 | | | | |
| | 5 | 75 | 0.008 | 1 | 0.0 | 17 | 0.011 | | |
| | 6 | 75 | 0.003 | 15 | 0.0 | | | | |
| | 7 | 75 | 0.0 | 15 | 0.0 | | | | |
| | 8 | 75 | 0.0 | 25 | 0.0 | | | | |
| | 9 | 75 | 0.0 | 20 | 0.0 | | | | |
| 462281 | 10 | 74 | 0.0 | 12 | 0.0 | | | | |
| | 11 | 74 | 0.0 | 16 | 0.0 | 3 | 0.0 | 6 | 0.0 |
| | 12 | 74 | 0.0 | 14 | 0.0 | 8 | 0.0 | 16 | 0.0 |
| | 1 | 75 | 0.0 | 25 | 0.0 | 19 | 0.0 | | |
| | 2 | 75 | 0.0 | 18 | 0.0 | 8 | 0.0 | | |
| | 3 | 75 | 0.0 | 20 | 0.0 | 1 | 0.0 | | |
| | 4 | 75 | 0.0 | 14 | 0.0 | 12 | 0.0 | | |
| | 5 | 75 | 0.0 | 17 | 0.0 | 1 | 0.0 | | |
| | 6 | 75 | 0.000 | 19 | 0.000 | 15 | 0.0 | | |
| | 7 | 75 | 0.0 | 12 | 0.0 | 15 | 0.0 | | |
| | 8 | 75 | 0.0 | 25 | 0.0 | | | | |
| | 9 | 75 | 0.0 | 6 | 0.0 | 22 | 0.0 | | |
| 4622ZZ | 10 | 74 | 0.0 | | | | | | |
| | 11 | 74 | 0.0 | | | | | | |
| | 12 | 74 | 0.0 | | | | | | |
| | 1 | 75 | 0.0 | | | | | | |
| | 2 | 75 | 0.0 | | | | | | |
| | 3 | 75 | 0.0 | | | | | | |
| | 4 | 75 | 0.0 | | | | | | |
| | 5 | 75 | 0.003 | | | | | | |
| | 6 | 75 | 0.003 | | | | | | |
| | 7 | 75 | 0.0 | | | | | | |
| | 8 | 75 | 0.0 | | | | | | |
| | 9 | 75 | 0.0 | | | | | | |

# APPENDIX D

## PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/05/03

462201
44 32 50.0 097 04 50.0 4
LAKE POINSETT
46057 SOUTH DAKOTA

090791

11EPALES 2111202
0010 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00010 WATER TEMP CENT | 00300 DO MG/L | 00077 TRANSP SECCHI INCHES | 00094 CNDUCTVY FIELD MICROMHO | 00400 PH SU | 00410 T ALK CACO3 MG/L | 00610 NH3-N TOTAL MG/L | 00625 TOT KJEL N MG/L | 00630 NO2&NO3 N-TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 74/04/25 | 09 | 50 0000 | 9.6 | | 45 | 776 | | 214 | 0.050 | 0.200 | 0.100 | 0.007 |
| | 09 | 50 0005 | 9.5 | 10.2 | | 777 | | 202 | 0.320 | 2.200 | 0.230 | 0.022 |
| 74/07/12 | 10 | 15 0000 | 24.5 | 7.8 | 18 | 1182 | 9.20 | 252 | 0.110 | 3.200 | 0.160 | 0.067 |
| | 10 | 15 0005 | 24.5 | 6.8 | | 1179 | 9.20 | 338 | 0.130 | 3.000 | 0.140 | 0.090 |
| 74/09/19 | 13 | 55 0000 | 16.0 | 9.4 | 36 | 1030 | 8.55 | 295 | 0.040 | 2.300 | 0.020K | 0.006 |
| | 13 | 55 0007 | 15.9 | 9.2 | | 1037 | 8.55 | 285 | 0.040 | 2.300 | 0.020K | 0.007 |

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00665 PHOS-TOT MG/L P | 32217 CHLRPHYL A UG/L | 00031 INCDT LT REMNING PERCENT |
|---|---|---|---|---|---|
| 74/04/25 | 09 | 50 0000 | 0.052 | 23.7 | |
| | 09 | 50 0005 | 0.094 | | |
| 74/07/12 | 10 | 15 0000 | 0.196 | 132.1 | |
| | 10 | 15 0005 | 0.241 | | |
| 74/09/19 | 13 | 55 0000 | 0.087 | 39.5 | |
| | 13 | 55 0006 | | | 1.0 |
| | 13 | 55 0007 | 0.094 | | |

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/05/03

462202
44 34 00 0 097 04 30.0 4
LAKE POINSETT
46057 SOUTH DAKOTA

090791

11EPALES 2111202
0016 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00010 WATER TEMP CENT | 00300 DO MG/L | 00077 TRANSP SECCHI INCHES | 00094 CNDUCTVY FIELD MICROMHO | 00400 PH SU | 00410 T ALK CACO3 MG/L | 00610 NH3-N TOTAL MG/L | 00625 TOT KJEL N MG/L | 00630 NO2&NO3 N-TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 74/04/25 | 10 00 | 0000 | 9.8 | | 40 | 775 | | 214 | 0.270 | 2.300 | 0.240 | 0.010 |
| | 10 00 | 0005 | 9.6 | 9.2 | | 775 | | 202 | 0.280 | 2.700 | 0.240 | 0.039 |
| | 10 00 | 0012 | 9.5 | 8.4 | | 774 | | 210 | 0.290 | 2.900 | 0.250 | 0.047 |
| 74/07/12 | 10 00 | 0000 | 24.1 | 5.0 | 18 | 1193 | 8.90 | 270 | 0.420 | 2.800 | 0.200 | 0.106 |
| | 10 00 | 0005 | 24.0 | 5.0 | | 1192 | 8.80 | 270 | 0.440 | 2.800 | 0.180 | 0.099 |
| | 10 00 | 0009 | 24.0 | 5.0 | | 1193 | 8.80 | 272 | 0.420 | 2.800 | 0.140 | 0.100 |
| 74/09/19 | 14 10 | 0000 | 16.1 | 9.0 | 30 | 1037 | 8.50 | 325 | 0.050 | 2.300 | 0.020 | 0.006 |
| | 14 10 | 0005 | 16.1 | 9.2 | | 1038 | 8.49 | 310 | 0.040 | 2.300 | 0.020 | 0.005 |
| | 14 10 | 0010 | 16.1 | 9.4 | | 1035 | 8.42 | 245 | 0.050 | 2.300 | 0.020 | 0.006 |

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00665 PHOS-TOT MG/L P | 32217 CHLRPHYL A UG/L | 00031 INCDT LT REMNING PERCENT |
|---|---|---|---|---|---|
| 74/04/25 | 10 00 | 0000 | 0.060 | 24.3 | |
| | 10 00 | 0005 | 0.157 | | |
| | 10 00 | 0012 | 0.174 | | |
| 74/07/12 | 10 00 | 0000 | 0.214 | 31.3 | |
| | 10 00 | 0005 | 0.233 | | 1.0 |
| | 10 00 | 0009 | 0.186 | | |
| 74/09/19 | 14 10 | 0000 | 0.095 | 25.5 | |
| | 14 10 | 0004 | | | 1.0 |
| | 14 10 | 0005 | 0.099 | | |
| | 14 10 | 0010 | 0.108 | | |

21

STORET RETRIEVAL DATE 76/05/03

462203
44 35 30.0 097 04 00.0 4
LAKE POI[illegible]ETT
46057 SOUTH DAKOTA
090791

11EPALES 2111202
0010 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00010 WATER TEMP CENT | 00300 DO MG/L | 00077 TRANSP SECCHI INCHES | 00094 CNDUCTVY FIELD MICROMHO | 00400 PH SU | 00410 T ALK CACO3 MG/L | 00610 NH3-N TOTAL MG/L | 00625 TOT KJEL N MG/L | 00630 NO2&NO3 N-TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 74/04/25 | 10 | 30 0000 | 10.2 | | 31 | 780 | | 212 | 0.270 | 2.500 | 0.240 | 0.020 |
| | 10 | 30 0005 | 9.8 | 10.0 | | 783 | | 180 | 0.280 | 2.600 | 0.230 | 0.025 |
| 74/07/12 | 09 | 35 0000 | 24.5 | 6.2 | 36 | 1187 | 8.90 | 266 | 0.140 | 3.000 | 0.160 | 0.078 |
| | 09 | 35 0005 | 24.5 | 6.0 | | 1184 | 8.90 | 268 | 0.150 | 2.700 | 0.180 | 0.094 |
| | 09 | 35 0010 | 24.3 | 6.4 | | 1187 | 8.90 | 264 | 0.170 | 2.600 | 0.190 | 0.088 |
| 74/09/19 | 14 | 30 0000 | 16.3 | 9.0 | 30 | 1048 | 8.53 | 315 | 0.050 | 2.300 | 0.020 | 0.006 |
| | 14 | 30 0007 | 16.3 | 8.6 | | 1049 | 8.44 | 305 | 0.040 | 2.300 | 0.020 | 0.005 |

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00665 PHOS-TOT MG/L P | 32217 CHLRPHYL A UG/L | 00031 INCDT LT REMNING PERCENT |
|---|---|---|---|---|---|
| 74/04/25 | 10 | 30 0000 | 0.070 | 7.4 | |
| | 10 | 30 0005 | 0.122 | | |
| 74/07/12 | 09 | 35 0000 | 0.166 | 49.4 | |
| | 09 | 35 0005 | 0.220 | | |
| | 09 | 35 0006 | | | 1.0 |
| | 09 | 35 0010 | 0.199 | | |
| 74/09/19 | 14 | 30 0000 | 0.095 | 28.7 | |
| | 14 | 30 0007 | 0.097 | | |

# APPENDIX E

# TRIBUTARY DATA

STORET RETRIEVAL DATE 76/05/04

4622A1
44 36 48.0 097 00 22.0 4
UNNAMED STREAM
46 7.5 LK POINSETT
O/POINSETT LAKE 090791
SEC RD BRDG 2.8 MI ENE OF STONE BRIDGE
11EPALES 2111204
0000 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 NO2&NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|---|---|---|---|---|---|---|---|
| 75/05/17 | 19 00 | | 1.100 | 2.200 | 0.575 | 0.240 | 0.390 |
| 75/08/25 | 16 30 | | 0.005 | 7.300 | 0.130 | 0.095 | 0.660 |

STORET RETRIEVAL DATE 76/05/04

462281
44 33 45.0 097 07 40.0 4
UNNAMED STREAM
46 7.5 LAKE NORDEN
T/POINSETT LAKE 090791
US HWY 81 +ROG 2.6 MI S OF ALSVILLE
11EPALES 2111204
0000 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 NO2&NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|---|---|---|---|---|---|---|---|
| 75/04/14 | 08 00 | | 12.000 | 4.850 | 1.480 | 1.300 | 1.250 |
| 75/05/17 | 18 45 | | 2.600 | 2.400 | 0.240 | 0.590 | 0.660 |

STORET RETRIEVAL DATE 76/05/04

4622C1
44 35 00.0 097 08 35.0 4
UNNAMED STREAM
46 7.5 LK POINSETT
T/POINSETT LAKE 090791
SEC RD BRG 1 MI E OF ALSVILLE
11EPALES 2111204
0000 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 NO2&NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|---|---|---|---|---|---|---|---|
| 75/05/17 | 18 30 | | 0.200 | 2.200 | 0.430 | 0.460 | 0.520 |

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